


05/25/00

Type a plus sign inside this box 

PTO/SB/05 (12/97)

Approved for use through 09/30/00, OMB 0651-0032

UTILITY PATENT APPLICATION TRANSMITTAL

(For new nonprovisional applications under 37 CFR 1.53(b))

Attorney Docket No. 31529.0001 Total Pages 28
First Named Inventor or Application Identifier
Dieter Guldenfels
Express Mail Label No. EK522132174US

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents

ADDRESS TO: Assistant Commissioner for Patents
Box Patent Application
Washington, D.C. 20231

1. ☒ Fee Transmittal Form
(Submit an original, and a duplicate for fee processing)
2. ☒ Specification [Total Pages / 18 /]
(preferred arrangement set forth below)
 - Descriptive title of the Invention
 - Cross References to Related Applications
 - Statement Regarding Fed sponsored R&D
 - Reference to Microfiche Appendix
 - Background of the Invention
 - Brief Summary of the Invention
 - Brief Description of the Drawings (if filed)
 - Detailed Description
 - Claim(s)
 - Abstract of the Disclosure
3. ☒ Drawing(s) (35 USC 113) [Total Sheets / 8 /]
4. ☒ Oath or Declaration [Total Pages / 2 /]
 - a. ☒ Newly executed (original or copy)
 - b. ☐ Copy from a prior application (37 CFR 1.63(d))
(for continuation/divisional with Box 17 completed)
[Note Box 5 below]
 - i. ☐ **DELETION OF INVENTOR(S)**
Signed statement attached deleting inventor(s) named in the prior application, see 37 CFR 1.63(d)(2) and 1.33(b).
5. ☐ Incorporation By Reference (available if Box 4b is checked)
The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied under Box 4b, is considered as being part of the disclosure of the accompanying application and is hereby incorporated by reference therein.
6. ☐ Microfiche Computer Program (Appendix)
7. Nucleotide and/or Amino Acid Sequence Submission (if applicable, all necessary)
 - a. ☐ Computer Readable Copy
 - b. ☐ Paper Copy (identical to computer copy)
 - c. ☐ Statement verifying identity of above copies

ACCOMPANYING APPLICATION PARTS

8. ☒ Assignment Papers (cover sheet & document(s))
9. ☐ 37 CFR 3.73(b) Statement ☐ Power of Attorney
(when there is an assignee)
10. ☐ English Translation Document (if applicable)
11. ☐ Information Disclosure ☐ Copies of IDS
Statement (IDS)/PTO-1449 Citations
12. ☐ Preliminary Amendment
13. ☒ Return Receipt Postcard (MPEP 503)
(Should be specifically itemized)
14. ☐ Small Entity ☐ Statement filed in prior application,
Statement(s) Status still proper and desired
15. ☐ Certified Copy of Priority Document(s)
(if foreign priority is claimed)
16. ☒ Other: Check: \$690

17. If a CONTINUING APPLICATION, check appropriate box and supply the requisite information:

☐ Continuation ☐ Divisional ☐ Continuation-in-part (CIP) of the prior application No: /

18. CORRESPONDENCE ADDRESS

NAME	David L. Principe					
	Hodgson, Russ, Andrews, Woods & Goodyear, LLP					
ADDRESS	One M&T Plaza, Suite 2000					
CITY	Buffalo	STATE	New York	ZIP CODE	14203-2391	
COUNTRY	United States of America	TELEPHONE	(716) 856-4000	FAX	(716) 849-0349	

*Express Mail® Mailing Label Number EK522132174US

Date of Deposit May 25, 2000

I hereby Certify that this paper or fee is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 CFR 1.10 on the date indicated above and is addressed to the Assistant Commissioner for Patents, Washington, D.C. 20231.

David L. Principe

Name
85392397_0000C

Signature



RADIUS CONVEYOR BELT**FIELD OF INVENTION**

This invention relates to conveyor belts and, more particularly, to modular plastic conveyor belts formed of rows of plastic belt modules pivotally interlinked by transverse pivot rods.

BACKGROUND OF THE INVENTION

Because they do not corrode, are light weight, and are easy to clean, unlike metal conveyor belts, plastic conveyor belts are used widely, especially in conveying food products. Modular plastic conveyor belts are made up of molded plastic modular links, or belt modules, that can be arranged side by side in rows of selectable width. A series of spaced apart link ends extending from each side of the modules include aligned apertures to accommodate a pivot rod. The link ends along one end of a row of modules are interconnected with the link ends of an adjacent row. A pivot rod journaled in the aligned apertures of the side-by-side and end-to-end connected modules forms a hinge between adjacent rows. Rows of belt modules are connected together to form an endless conveyor belt capable of articulating about a drive sprocket.

In many industrial applications, conveyor belts are used to carry products along paths including curved segments. Belts capable of flexing sidewise to follow curved paths are referred to as side-flexing, turn, or radius belts. As a radius belt negotiates a turn, the belt must be able to fan out because the edge of the belt at the outside of the turn follows a longer path than the edge at the inside of the turn. In order to fan out, a modular plastic radius belt typically has provisions that allow it to collapse at the inside of a turn or to spread out at the outside of the turn.

Apertures slotted in the direction of travel of the

belt are commonly provided in the link ends on at least one side of the modules to facilitate the collapsing and spreading of the belt.

The requirement of following a curved path causes problems not found in straight-running belts. As one example, radius belts, especially if tightly tensioned or running fast and lightly loaded, tend to rise out of the conveyor support around a turn. As another example, because belt pull is concentrated in the outer portion of the belt as it rounds a turn, outer link ends are more likely to fail unless otherwise strengthened or bolstered.

There are other problems with some common belt designs. For example, stresses can be molded into the plastic modules during the manufacturing process. Sharp, as opposed to curved, junctions between molded features on a belt module are more likely to form concentrated stress regions. When such modules make up a conveyor belt, operation of the belt increases the stress in those regions. In a radius belt, in which the pulling load is unevenly distributed across the width of the belt as it rounds a turn, the problem is exacerbated. One way to solve the problem is to add more material to the belt, but that makes the belt heavier, increases the production cost due to the larger molding cycle and closes in some of the desirable open area that allows for drainage or air flow.

Another problem with some structures of radius belts is compression of the modules transverse to the direction of belt travel. A radius belt bricklaid to a width of, for example one meter, may compress by three to four millimeters as the belt rounds a turn, which can cause the belt to come out of the conveyor support. Belts having the corrugated configuration shown in U.S. Patent No. 5,372,248 to Horton are especially susceptible to bending and compression of this type.

What is needed is a modular radius conveyor belt that is resistant to compression and that improves the engagement of the belt to the drive sprocket.

5 SUMMARY OF THE INVENTION

The present invention meets the above-described need by providing an endless conveyor belt formed of plastic belt modules and capable of following a curved path. The modules include first and second module
10 surfaces, i.e., a top, product-conveying surface and a bottom, sprocket-driven surface. An intermediate section extends across the width of each module transverse to the direction of belt travel. The intermediate section is formed in part by a web and in
15 part by a thin, corrugated strip having a pair of essentially parallel walls. The corrugated strip forms a series of regularly spaced alternating ridges and valleys along each wall. Link ends extend outward from the ridges on each wall of the corrugated strip. Each
20 link end has a leg portion attached at a ridge of the strip and a thick distal portion at the end of the link end distant from the corrugated strip. Transverse holes in the link ends extending from respective walls of a module are aligned to accommodate a pivot rod. When the
25 link ends of consecutive rows of side-by-side modules are intercalated, the pivot rod serves as a hinge pin in a hinged joint between consecutive interlinked rows. To permit the belt to follow a curved path, the pivot rod openings in at least one of the link ends extending from
30 one of the walls of the corrugated strip are slotted longitudinally in the direction of belt travel.

The belt is driven by engagement of the sprocket tooth with the curved outside surface of the link ends. The link end engaged by the sprocket tooth is subjected
35 to a compressive force rather than an undesirable tensile force. Thus, the link ends provide pull

strength, resistance to belt and sprocket wear, and sprocket drivability. As an alternative, a central portion of a link end disposed in the middle belt modules may also engage with a tooth on the drive sprocket. Because the mid modules do not have to collapse fully, they may be formed with a thicker and fully straight cross-rib.

Each wall of the corrugated strip forms a series of arched recesses with the leg portions of the link ends. The recesses are large enough to provide room for a thick link end of an interlinked module of an adjacent row to collapse into the recess or to rotate as belt rows fan out going around a turn. Because the recesses along one wall overlap in a transverse direction with the recesses along the other wall, additional space for collapsing is provided.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention is illustrated in the drawings in which like reference characters designate the same or similar parts throughout the figures of which:

Fig. 1 is a top plan view of a radius conveyor belt of the present invention with a portion of one of the belt modules cutaway;

Fig. 2 is a top plan view of a belt module of the present invention;

Fig. 3 is an end elevation view of a belt module of the present invention;

Fig. 4 is a sectional view taken along lines 4-4 of Fig. 2;

Fig. 5 is a bottom plan view of a belt module of the present invention;

Fig. 6 is a top perspective view of the belt module of the present invention;

Fig. 7 is a bottom perspective view of the belt

module of the present invention;

Fig. 8 is a top plan view of an alternate embodiment of a belt module suitable for use in the middle of a bricklaid modular radius conveyor belt according to the present invention;

Fig. 9 is a bottom plan view of the belt module of Fig. 8;

Fig. 10 is an end elevational view of the belt module of Fig. 8;

Fig. 11 is a section view taken along lines 11-11 of Fig. 8;

Fig. 12 is a top plan view of an alternate embodiment of the belt module of the present invention;

Fig. 13 is a sectional view taken along lines 13-13 of Fig. 12;

Fig. 14 is a side elevation view of a drive sprocket engaging the radius conveyor belt of the present invention; and,

Fig. 15 is a cutaway side elevation view of a drive sprocket engaging with the link end and center cross-rib of the mid modules of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings, Figs. 1 to 7 show a first embodiment of a portion of a modular belt 20 of the present invention. The portion of the modular belt 20 shown is formed from molded plastic modules 23, 26 and 29. For reference, the direction of belt travel is indicated by arrow 32, however, the belt of the present invention may be conveyed in either direction. A pivot rod 35 connects adjacent belt modules by passing through openings in the modules disposed transverse to the direction of belt travel.

As shown in Fig. 2, an exemplary one of the belt module 26 has an intermediate section 38 supporting a plurality of first link ends 41 and a plurality of

second link ends 44. The first link ends 41 are disposed in the direction of belt travel indicated by arrow 32 and the plurality of second link ends 44 extend opposite the first link ends 41. As will be described in detail hereinafter, the intermediate section 38 is comprised of an upper, transverse stiffening web 47 forming into a lower corrugated portion 50. The corrugated portion 50 forms a series of ridges 53 and valleys 56 in a sinusoidal manner. Along with the transverse web 47 of the intermediate section 38, the ridges 53 extending toward the left of Fig. 2 support the first link ends 41 while the ridges 53 extending toward the right in the drawing support the second link ends 44.

The first link ends 41 include a leg portion 59 connected to an intermediate section 62 and extending to a distal head portion 65. In a similar manner, the second link ends 44 include a leg portion 68 connected to the intermediate section 71 and extending to a distal head portion 74.

With respect to the orientation shown in Figs. 2 to 4, the intermediate section 38 formed of the stiffening web 47 and the corrugated portion 50 is comprised of an upper surface 77 extending to and meeting with opposed left and right walls 80 and 83 which, in turn, meet with a lower surface 86 of the module. The left wall 80 is comprised of an upper wall 89, which is part of the stiffening web 47, and extends downwardly to a curved wall 92 which forms into a lower vertical wall 95. The curved wall 92 and the lower vertical wall 95 are part of the corrugated portion 50 of the intermediate section 38. The lower vertical wall 95 extends to the lower surface 86 of the module which, in turn, extends to and meets with the right vertical wall 83.

As shown in Fig. 2, the head portion 65 is preferably larger than the leg portion 59. Accordingly,

the head portion 65 is connected to the leg portion 59 by the angled intermediate section 62. The head portion 65 is preferably formed with two substantially parallel sides 98 and 101 connected by an outer end 104. The corners between the sides 98, 101 and ends 104 are preferably radiused to be smooth and to protect the conveyed product from damage.

An opening 107 is defined between spaced apart sides 110, 113 of adjacent link ends. At a distal end 116, the ends of adjacent links form the mouth 119 of the opening 107. At the opposite end 122, the opening 107 terminates in the multi-level surface defined by the web 47 and corrugated portion 50 as described above. The top level of the surface (best shown in Fig. 1) is defined by wall 89 of the web 47. The corners where the side walls of the link ends 41 meet the straight wall 89 of web 47, are also radiused to be smooth and to protect the conveyed product from damage.

In Fig. 5, the bottom level of the surface is defined by the relatively thin corrugated portion 50 having a pair of essentially parallel walls 125, 128. The corrugated portion 50 forms the series of regularly spaced alternating ridges 53 and valleys 56 along the intermediate section 38 as described herein.

Returning to Fig. 2, the straight wall 89 is shown bordering the opening 107. The curved surface defined by corrugated portion 50 is shown in broken lines. The curved surface receives link ends from an adjacent belt module such that the belt 20 is capable of collapsing for movement around a curved path as described in detail herein.

The plurality of second link ends 44 extend from the belt module 26 in the opposite direction from the first link ends 41. The second link ends 44 have the same overall shape as the first link ends 41 (except for the last link end 45) and are designed to fit into the

openings between the first link ends 41 such that adjacent belt modules can be intercalated and pivotally connected by the pivot rods 35.

As shown in Fig. 3, the belt module 26 includes a slot 134 that is disposed through the link ends 41 transverse to the direction of belt travel. The slot 134 extends in the direction of belt travel such that it is generally oblong. The slot 134 receives the pivot rod 35. The pivot rod 35 passes through the slots 134 in the first link ends 41 and through the openings 137 in the second link ends 44 (as shown in Fig. 1). The openings 137 correspond to the shape of the shaft 138 (Fig. 1) of the pivot rod 35 such that the pivot rod 35 is received through the opening 137 but in contrast to slot 134, the pivot rod 35 preferably cannot move in the direction of belt travel inside opening 137. Due to the oblong shape of slot 134, the pivot rod 35 can pivot inside the slot 134 such that the belt 20 is capable of collapsing on one side while the other side fans out due to the pivoting of rod 35 and the nesting of the link ends 41, 44 and cooperating spaces in the adjacent belt modules.

The last link end 45 of the belt module 26 includes a second opening 140 disposed around opening 137 to provide for countersinking a head (not shown) at the end of the pivot rod shaft 138.

The back surface of the last link end 45 includes a rounded surface 143 that provides clearance for pivoting an adjacent link end 45.

In Fig. 4, the transverse slot 134 in link ends 41 and the transverse opening 137 in link ends 44 receive pivot rods 35 to connect adjacent belt modules 23 and 29 as shown in Fig. 1. The web 47 is coterminous with the top surface 77 of the belt module 26 and terminates at the top of the corrugated portion 50 that defines the space between adjacent link ends (best shown in Fig. 5).

The outer ends 104 of the link ends 41 and 44 are radiused in a smooth rounded surface 146. The rounded surface 146 preferably comprises a rounded surface having a constant radius and provides a driving surface for engagement with the drive sprocket 149 as described herein.

Also, the curvature of the outer ends 104 of the link ends enables the links to clear the web 47 when the adjacent modules collapse along the edge. The clearance enables the link ends to extend under the web 47 into the space defined by the corrugated portion 50 (best shown in Figs. 6-7). In this manner, the web 47 partially hoods the link ends when the belt 20 collapses. Accordingly, the belt module 26 provides a web 47 for structural stability while maintaining a corrugated portion 50 to allow for recesses that provide maximum space for collapsing the belt modules around a curved path.

Turning to Figs. 8-11, an alternate embodiment comprising belt module 200 is shown. Belt module 200 is suitable for center modules in a bricklaid belt.

The belt module 200 includes link ends 206, 207 which are supported by an intermediate section 208. The link ends 206 have a slot 209 disposed transverse to the direction of belt travel indicated by arrow 211. Link ends 207 have a transverse opening 213 that corresponds to the shaft 138 of pivot rod 35.

As shown in Fig. 9, the belt module 200 has a web 212 that is part of the intermediate section 208 and that is wider than the corrugated portion 50 of the edge module 26 shown in Figs. 1-7 (best shown in Fig. 5). In Fig. 8, the opening 218 between the link ends 206 is defined by a mouth 221 at one end 224 and is defined at the opposite end 227 by a multilevel surface defined by the web 212 and by a straight wall portion 230 that joins with the link end in a curved section 233.

As shown in Figs. 10 and 11, the bottom of the intermediate section 208 of the link ends is angled to provide a face 236 for engagement of the intermediate section 208 with the teeth 148 on the drive sprocket 149 (Fig. 14). The drive sprocket 149 is described in detail hereafter.

The link ends 207 have the transverse opening 213 capable of receiving the pivot rod 35. Link ends 206 have the transverse slot 209 that is oblong and extends in the direction of belt travel such that the pivot rod 35 can move inside the slot 209 to pivot and facilitate collapsing.

The engagement of the face 236 on the central portion 215 with the tooth 148 on the drive sprocket 149 (shown in Fig. 15) assists in maintaining engagement between the belt 20 and the drive sprocket 149 and assists in driving the belt 20. The primary drive mechanism is described in detail below.

Turning to Figs. 12-13, belt module 300 is an alternate embodiment of belt modules 23, 26, 29 of Figs. 1-7. Belt module 300 differs from the previous modules because the slot and the holes are positioned off center on the link ends 303 and 306, respectively. The transverse slot 309 and transverse openings 312 are located lower on the belt module 300 which provides for increased module strength. The distance 315 from the top surface 318 to the center 321 of the opening 312 is greater than the distance 316 from the center 321 of the opening 312 to the bottom surface 324. Also, the link end 303 with the transverse slot 309 is designed such that the radius of curvature at the rounded end is greater above the slot 309 than it is below the slot 309.

As an option, the belt module 26 includes a plurality of openings 331 that provide for reducing the weight and material cost for the belt 20 and provide

open areas for cleaning the belt 20. The vertical openings 331 in the link ends 306 are shown in Fig. 13.

Turning to Figs. 14 and 15, the belt modules 20 (Figures 1-7) are shown driven by the teeth 148 on the drive sprocket 149. The drive sprocket 149 is center driven by a rotating shaft (not shown) as known to those of ordinary skill in the art. The teeth 148 engage with the rounded surface 146 on the outside of the link ends and push the link ends forward. In addition to the engagement of the teeth on the rounded surface 146 of the link ends, the central portions 215 (Fig. 15) of the middle modules push against the teeth along the angled face 236.

While the invention has been described in connection with certain preferred embodiments, it is not intended to limit the scope of the invention to the particular forms set forth, but, on the contrary, it is intended to cover such alternatives, modifications, and equivalents as may be included within the spirit and scope of the invention as defined by the appended claims.

WHAT IS CLAIMED IS:

1. A belt module, which comprises:

- 5 a) an intermediate section having opposed first and second walls, wherein the intermediate section has a width and a thickness defined by an upper surface and a lower surface and wherein the intermediate section comprises a web portion extending across the width between the first and second walls from one of the upper and lower surfaces to a portion of the way through the thickness of the intermediate section to form into a corrugated portion extending across the width between the first and second walls to the other of the upper and lower surfaces, wherein the corrugated portion has a series of regularly spaced ridges and grooves across the width of the module;
- 10 b) a first plurality of link ends extending outwardly from the web portion and the ridges on the first wall of the corrugated portion;
- 15 c) a second plurality of link ends extending outwardly from the web portion and the ridges on the second wall of the corrugated portion and in a direction opposite the first link ends; and,
- 20 d) transverse openings provided in each of the first and second link ends, wherein at least the openings in one of the first and second link ends is elongated in a direction along an axis of the link end extending from the intermediate section.

25 2. The belt module of Claim 1, wherein the first and second link ends each have a leg portion with substantially parallel sidewalls.

30 3. The belt module of Claim 2, wherein the first and second link ends each have a head portion that is wider than the leg portion, the head portion having a pair of

35

substantially parallel sidewalls and an endwall.

4. The belt module of Claim 3, wherein a junction of the sidewalls and endwall of the head portion is rounded.

5. The belt module of Claim 4, wherein the endwall of the head portion is rounded and connects a top surface of the link end to a bottom surface of the link end.

6. The belt module of Claim 1, further comprising an opening disposed through the belt module from the top surface to the bottom surface.

7. A radius conveyor belt, comprising:

a plurality of belt modules having a plurality of first link ends disposed in the direction of belt travel and having a plurality of second link ends disposed in the opposite direction, an intermediate section disposed between the first and second link ends and having a web and a corrugated portion disposed adjacent to the web the first and second link ends disposed such that a space capable of receiving a link end is formed between each adjacent link end, the space being open at one end and terminating in an rounded region at the opposite end, the plurality of first link ends being offset from the plurality of second link ends such that the first link ends align with the space between the second link ends such that adjacently positioned belt modules are capable of intercalating so that the first link ends of one belt module fit into the spaces defined between the second link ends of an adjacent belt module, the plurality of first link ends having a slot defined therein, the slot disposed transverse to the direction of belt travel and extending in the direction of belt travel, the plurality of second link ends having a

transverse opening defined therein; and,

5 a pivot rod extending transverse to the direction
of belt travel through the openings in the second link
end of one of the plurality of belt modules and
extending through the slotted openings in the first link
end of an adjacent belt module such that the first and
second link ends of the adjacent belt modules are
intercalated and the adjacent belt modules are
interlinked into adjacent hinged rows capable of
10 following a curved path.

8. The radius conveyor belt of Claim 7, wherein the
first and second link ends each have a leg portion with
substantially parallel sidewalls.

15

9. The radius conveyor belt of Claim 8, wherein the
first and second link ends each have a head portion that
is wider than the leg portion, the head portion having a
pair of substantially parallel sidewalls and an endwall.

20

10. The radius conveyor belt of Claim 9, wherein a
junction of the sidewalls and endwall of the head
portion is rounded.

25

11. The radius conveyor belt of Claim 9, wherein the
endwall of the head portion is rounded and connects a
top surface of the link end to a bottom surface of the
link end.

30

12. The radius conveyor belt of Claim 7, further
comprising an opening disposed through the belt module
from the top surface to the bottom surface.

35

13. The radius conveyor belt of Claim 7, wherein the
web and corrugated portion form a multilevel surface
defining the end of the space between adjacent link

ends.

14. A conveying system, comprising:

- an endless radius conveyor belt, comprising a
- 5 plurality of belt modules having a plurality of first link ends disposed in the direction of belt travel and having a plurality of second link ends disposed in the opposite direction, the first and second link ends disposed such that a space capable of receiving a link
- 10 end is formed between each adjacent link end, the space being open at one end and terminating in an rounded region at the opposite end, the plurality of first link ends being offset from the plurality of second link ends such that the first link ends align with the space
- 15 between the second link ends such that adjacently positioned belt modules are capable of intercalating so that the first link ends of one belt module fit into the spaces defined between the second link ends of an adjacent belt module, the plurality of first link ends
- 20 having a slot defined therein, the slot disposed transverse to the direction of belt travel and extending in the direction of belt travel, the plurality of second link ends having a transverse opening defined therein;
- an intermediate portion disposed between the first
- 25 and second link ends and having a web and a corrugated portion, the web formed in the center of the belt modules and disposed such that a first side of the web terminates in a first surface of the belt module and a second side of the web terminates adjacent to the
- 30 corrugated portion;
- a pivot rod extending transverse to the direction of belt travel through the openings in the second link end of one of the plurality of belt modules and extending through the slotted openings in the first link
- 35 end of an adjacent belt module such that the first and second link ends of the adjacent belt modules are

intercalated and the adjacent belt modules are interlinked into adjacent hinged rows capable of following a curved path;

- at least one middle belt module having a central portion with an angled face, the central portion disposed adjacent to the web between the top and bottom surfaces of the belt module; and,

- a drive sprocket having teeth disposed around the perimeter thereof, the teeth capable of engaging with the rounded endwall of the link ends and capable of engaging with the angled face on the central portion of the middle module, to drive the endless conveyor belt around a conveying path.

- 15 15. The conveying system of Claim 14, wherein the first and second link ends each have a leg portion with substantially parallel sidewalls.

- 20 16. The conveying system of Claim 15, wherein the first and second link ends each have a head portion that is wider than the leg portion, the head portion having a pair of substantially parallel sidewalls and an endwall.

- 25 17. The conveying system of Claim 16, wherein a junction of the sidewalls and endwall of the head portion is rounded.

- 30 18. The conveying system of Claim 16, wherein the endwall of the head portion is rounded and connects a top surface of the link end to a bottom surface of the link end.

- 35 19. The conveying system of Claim 14, further comprising an opening disposed through the belt module from the top surface to the bottom surface.

20. The conveying system of Claim 14, wherein the web and rounded regions form a multilevel surface defining the end of the space between adjacent link ends.

11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
61
62
63
64
65
66
67
68
69
70
71
72
73
74
75
76
77
78
79
80
81
82
83
84
85
86
87
88
89
90
91
92
93
94
95
96
97
98
99
100
101
102
103
104
105
106
107
108
109
110
111
112
113
114
115
116
117
118
119
120
121
122
123
124
125
126
127
128
129
130
131
132
133
134
135
136
137
138
139
140
141
142
143
144
145
146
147
148
149
150
151
152
153
154
155
156
157
158
159
160
161
162
163
164
165
166
167
168
169
170
171
172
173
174
175
176
177
178
179
180
181
182
183
184
185
186
187
188
189
190
191
192
193
194
195
196
197
198
199
200
201
202
203
204
205
206
207
208
209
210
211
212
213
214
215
216
217
218
219
220
221
222
223
224
225
226
227
228
229
230
231
232
233
234
235
236
237
238
239
240
241
242
243
244
245
246
247
248
249
250
251
252
253
254
255
256
257
258
259
260
261
262
263
264
265
266
267
268
269
270
271
272
273
274
275
276
277
278
279
280
281
282
283
284
285
286
287
288
289
290
291
292
293
294
295
296
297
298
299
300
301
302
303
304
305
306
307
308
309
310
311
312
313
314
315
316
317
318
319
320
321
322
323
324
325
326
327
328
329
330
331
332
333
334
335
336
337
338
339
340
341
342
343
344
345
346
347
348
349
350
351
352
353
354
355
356
357
358
359
360
361
362
363
364
365
366
367
368
369
370
371
372
373
374
375
376
377
378
379
380
381
382
383
384
385
386
387
388
389
390
391
392
393
394
395
396
397
398
399
400
401
402
403
404
405
406
407
408
409
410
411
412
413
414
415
416
417
418
419
420
421
422
423
424
425
426
427
428
429
430
431
432
433
434
435
436
437
438
439
440
441
442
443
444
445
446
447
448
449
450
451
452
453
454
455
456
457
458
459
460
461
462
463
464
465
466
467
468
469
470
471
472
473
474
475
476
477
478
479
480
481
482
483
484
485
486
487
488
489
490
491
492
493
494
495
496
497
498
499
500
501
502
503
504
505
506
507
508
509
510
511
512
513
514
515
516
517
518
519
520
521
522
523
524
525
526
527
528
529
530
531
532
533
534
535
536
537
538
539
540
541
542
543
544
545
546
547
548
549
550
551
552
553
554
555
556
557
558
559
560
561
562
563
564
565
566
567
568
569
570
571
572
573
574
575
576
577
578
579
580
581
582
583
584
585
586
587
588
589
590
591
592
593
594
595
596
597
598
599
600
601
602
603
604
605
606
607
608
609
610
611
612
613
614
615
616
617
618
619
620
621
622
623
624
625
626
627
628
629
630
631
632
633
634
635
636
637
638
639
640
641
642
643
644
645
646
647
648
649
650
651
652
653
654
655
656
657
658
659
660
661
662
663
664
665
666
667
668
669
670
671
672
673
674
675
676
677
678
679
680
681
682
683
684
685
686
687
688
689
690
691
692
693
694
695
696
697
698
699
700
701
702
703
704
705
706
707
708
709
710
711
712
713
714
715
716
717
718
719
720
721
722
723
724
725
726
727
728
729
730
731
732
733
734
735
736
737
738
739
740
741
742
743
744
745
746
747
748
749
750
751
752
753
754
755
756
757
758
759
760
761
762
763
764
765
766
767
768
769
770
771
772
773
774
775
776
777
778
779
780
781
782
783
784
785
786
787
788
789
790
791
792
793
794
795
796
797
798
799
800
801
802
803
804
805
806
807
808
809
810
811
812
813
814
815
816
817
818
819
820
821
822
823
824
825
826
827
828
829
830
831
832
833
834
835
836
837
838
839
840
841
842
843
844
845
846
847
848
849
850
851
852
853
854
855
856
857
858
859
860
861
862
863
864
865
866
867
868
869
870
871
872
873
874
875
876
877
878
879
880
881
882
883
884
885
886
887
888
889
890
891
892
893
894
895
896
897
898
899
900
901
902
903
904
905
906
907
908
909
910
911
912
913
914
915
916
917
918
919
920
921
922
923
924
925
926
927
928
929
930
931
932
933
934
935
936
937
938
939
940
941
942
943
944
945
946
947
948
949
950
951
952
953
954
955
956
957
958
959
960
961
962
963
964
965
966
967
968
969
970
971
972
973
974
975
976
977
978
979
980
981
982
983
984
985
986
987
988
989
990
991
992
993
994
995
996
997
998
999
1000
1001
1002
1003
1004
1005
1006
1007
1008
1009
1010
1011
1012
1013
1014
1015
1016
1017
1018
1019
1020
1021
1022
1023
1024
1025
1026
1027
1028
1029
1030
1031
1032
1033
1034
1035
1036
1037
1038
1039
1040
1041
1042
1043
1044
1045
1046
1047
1048
1049
1050
1051
1052
1053
1054
1055
1056
1057
1058
1059
1060
1061
1062
1063
1064
1065
1066
1067
1068
1069
1070
1071
1072
1073
1074
1075
1076
1077
1078
1079
1080
1081
1082
1083
1084
1085
1086
1087
1088
1089
1090
1091
1092
1093
1094
1095
1096
1097
1098
1099
1100
1101
1102
1103
1104
1105
1106
1107
1108
1109
1110
1111
1112
1113
1114
1115
1116
1117
1118
1119
1120
1121
1122
1123
1124
1125
1126
1127
1128
1129
1130
1131
1132
1133
1134
1135
1136
1137
1138
1139
1140
1141
1142
1143
1144
1145
1146
1147
1148
1149
1150
1151
1152
1153
1154
1155
1156
1157
1158
1159
1160
1161
1162
1163
1164
1165
1166
1167
1168
1169
1170
1171
1172
1173
1174
1175
1176
1177
1178
1179
1180
1181
1182
1183
1184
1185
1186
1187
1188
1189
1190
1191
1192
1193
1194
1195
1196
1197
1198
1199
1200
1201
1202
1203
1204
1205
1206
1207
1208
1209
1210
1211
1212
1213
1214
1215
1216
1217
1218
1219
1220
1221
1222
1223
1224
1225
1226
1227
1228
1229
1230
1231
1232
1233
1234
1235
1236
1237
1238
1239
1240
1241
1242
1243
1244
1245
1246
1247
1248
1249
1250
1251
1252
1253
1254
1255
1256
1257
1258
1259
1260
1261
1262
1263
1264
1265
1266
1267
1268
1269
1270
1271
1272
1273
1274
1275
1276
1277
1278
1279
1280
1281
1282
1283
1284
1285
1286
1287
1288
1289
1290
1291
1292
1293
1294
1295
1296
1297
1298
1299
1300
1301
1302
1303
1304
1305
1306
1307
1308
1309
1310
1311
1312
1313
1314
1315
1316
1317
1318
1319
1320
1321
1322
1323
1324
1325
1326
1327
1328
1329
1330
1331
1332
1333
1334
1335
1336
1337
1338
1339
1340
1341
1342
1343
1344
1345
1346
1347
1348
1349
1350
1351
1352
1353
1354
1355
1356
1357
1358
1359
1360
1361
1362
1363
1364
1365
1366
1367
1368
1369
1370
1371
1372
1373
1374
1375
1376
1377
1378
1379
1380
1381
1382
1383
1384
1385
1386
1387
1388
1389
1390
1391
1392
1393
1394
1395
1396
1397
1398
1399
1400
1401
1402
1403
1404
1405
1406
1407
1408
1409
1410
1411
1412
1413
1414
1415
1416
1417
1418
1419
1420
1421
1422
1423
1424
1425
1426
1427
1428
1429
1430
1431
1432
1433
1434
1435
1436
1437
1438
1439
1440
1441
1442
1443
1444
1445
1446
1447
1448
1449
1450
1451
1452
1453
1454
1455
1456
1457
1458
1459
1460
1461
1462
1463
1464
1465
1466
1467
1468
1469
1470
1471
1472
1473
1474
1475
1476
1477
1478
1479
1480
1481
1482
1483
1484
1485
1486
1487
1488
1489
1490
1491
1492
1493
1494
1495
1496
1497
1498
1499
1500
1501
1502
1503
1504
1505
1506
1507
1508
1509
1510
1511
1512
1513
1514
1515
1516
1517
1518
1519
1520
1521
1522
1523
1524
1525
1526
1527
1528
1529
1530
1531
1532
1533
1534
1535
1536
1537
1538
1539
1540
1541
1542
1543
1544
1545
1546
1547
1548
1549
1550
1551
1552
1553
1554
1555
1556
1557
1558
1559
1560
1561
1562
1563
1564
1565
1566
1567
1568
1569
1570
1571
1572
1573
1574
1575
1576
1577
1578
1579
1580
1581
1582
1583
1584
1585
1586
1587
1588
1589
1590
1591
1592
1593
1594
1595
1596
1597
1598
1599
1600
1601
1602
1603
1604
1605
1606
1607
1608
1609
1610
1611
1612
1613
1614
1615
1616
1617
1618
1619
1620
1621
1622
1623
1624
1625
1626
1627
1628
1629
1630
1631
1632
1633
1634
1635
1636
1637
1638
1639
1640
1641
1642
1643
1644
1645
1646
1647
1648
1649
1650
1651
1652
1653
1654
1655
1656
1657
1658
1659
1660
1661
1662
1663
1664
1665
1666
1667
1668
1669
1670
1671
1672
1673
1674
1675
1676
1677
1678
1679
1680
1681
1682
1683
1684
1685
1686
1687
1688
1689
1690
1691
1692
1693
1694
1695
1696
1697
1698
1699
1700
1701
1702
1703
1704
1705
1706
1707
1708
1709
1710
1711
1712
1713
1714
1715
1716
1717
1718
1719
1720
1721
1722
1723
1724
1725
1726
1727
1728
1729
1730
1731
1732
1733
1734
1735
1736
1737
1738
1739
1740
1741
1742
1743
1744
1745
1746
1747
1748
1749
1750
1751
1752
1753
1754
1755
1756
1757
1758
1759
1760
1761
1762
1763
1764
1765
1766
1767
1768
1769
1770
1771
1772
1773
1774
1775
1776
1777
1778
1779
1780
1781
1782
1783
1784
1785
1786
1787
1788
1789
1790
1791
1792
1793
1794
1795
1796
1797
1798
1799
1800
1801
1802
1803
1804
1805
1806
1807
1808
1809
1810
1811
1812
1813
1814
1815
1816
1817
1818
1819
1820
1821
1822
1823
1824
1825
1826
1827
1828
1829
1830
1831
1832
1833
1834
1835
1836
1837
1838
1839
1840
1841
1842
1843
1844
1845
1846
1847
1848
1849
1850
1851
1852
1853
1854
1855
1856
1857
1858
1859
1860
1861
1862
1863
1864
1865
1866
1867
1868
1869
1870
1871
1872
1873
1874
1875
1876
1877
1878
1879
1880
1881
1882
1883
1884
1885
1886
1887
1888
1889
1890
1891
1892
1893
1894
1895
1896
1897
1898
1899
1900
1901
1902
1903
1904
1905
1906
1907
1908
1909
1910
1911
1912
1913
1914
1915
1916
1917
1918
1919
1920
1921
1922
1923
1924
1925
1926
1927
1928
1929
1930
1931
1932
1933
1934
1935
1936
1937
1938
1939
1940
1941
1942
1943
1944
1945
1946
1947
1948
1949
1950
1951
1952
1953
1954
1955
1956
1957
1958
1959
1960
1961
1962
1963
1964
1965
1966
1967
1968
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
2026
2027
2028
2029
2030
2031
2032
2033
2034
2035
2036
2037
2038
2039
2040
2041
2042
2043
2044
2045
2046
2047
2048
2049
2050
2051
2052
2053
2054
2055
2056
2057
2058
2059
2060
2061
2062
2063
2064
2065
2066
2067
2068
2069
2070
2071
2072
2073
2074
2075
2076
2077
2078
2079
2080
2081
2082
2083
2084
2085
2086
2087
2088
2089
2090
2091
2092
2093
2094
2095
2096
2097
2098
2099
2100
2101
2102
2103
2104
2105
2106
2107
2108
2109
2110
2111
2112
2113
2114
2115
2116
2117
2118
2119
2120
2121
2122
2123
2124
2125
2126
2127
2128
2129
2130
2131
2132
2133
2134
2135
2136
2137
2138
2139
2140
2141
2142
2143
2144
2145
2146
2147
2148
2149
2150
2151
2152
2153
2154
2155
2156
2157
2158
2159
2160
2161
2162
2163
2164
2165
2166
2167
2168
2169
2170
2171
2172
2173
2174
2175
2176
2177
2178
2179
2180
2181
2182
2183
2184
2185
2186
2187
2188
2189
2190
2191
2192
2193
2194
2195
2196
2197
2198
2199
2200
2201
2202
2203
2204
2205
2206
2207
2208
2209
2210
2211
2212
2213
2214
2215
2216
2217
2218
2219
2220
2221
2222
2223
2224
2225

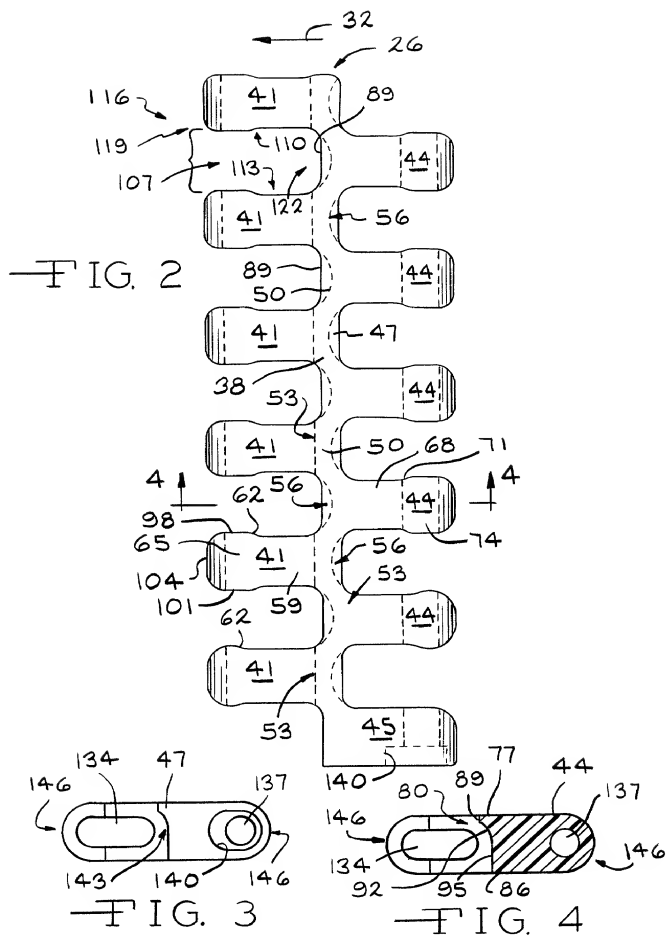
Abstract

A modular conveyor belt formed of rows of belt modules pivotally interlinked by transverse pivot rods and specially adapted for following a curved conveyor path. The modules include a top, product conveying surface and a bottom, sprocket-driven surface. The belt modules have a plurality of first link ends disposed in the direction of travel of the conveyor belt and a plurality of second link ends disposed in the opposite direction. Transverse holes in the link ends are aligned to accommodate a pivot rod. When the link ends of the consecutive rows of side by side modules are intercalated, the pivot rod serves as a hinge pin in a hinged joint between consecutive interlinked rows. To permit the belt to flex sidewise, the openings in the first link ends are slotted longitudinally in the direction of belt travel.

20

BPLODOCS:376283_1 (82CB01)

+



+

+

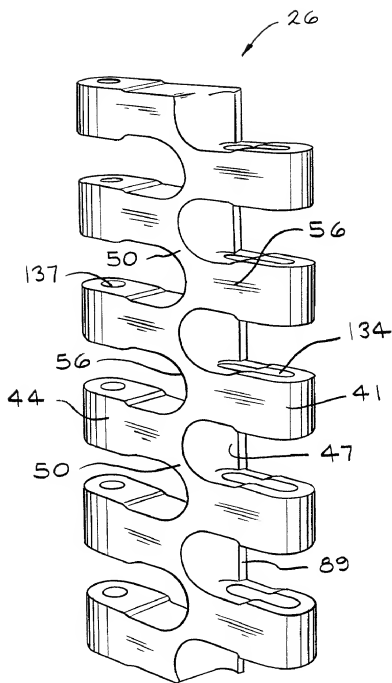


FIG. 7

+

+

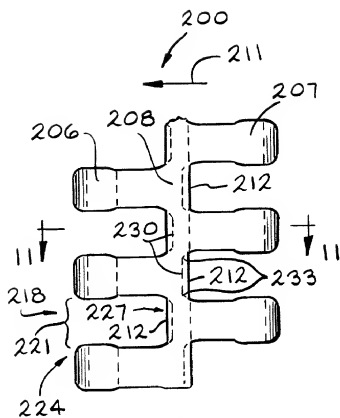


FIG. 8

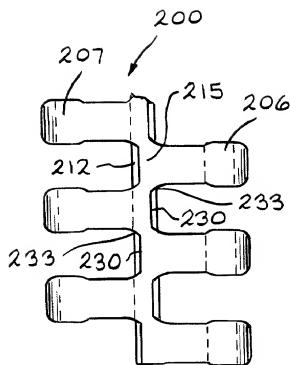


FIG. 9

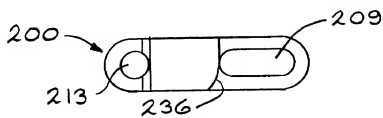


FIG. 10

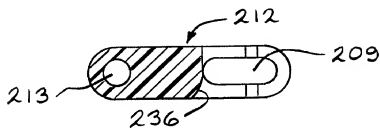


FIG. 11

+

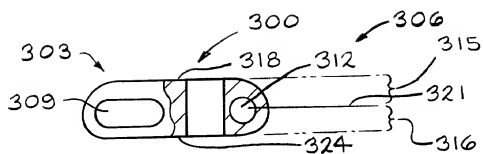


FIG. 13

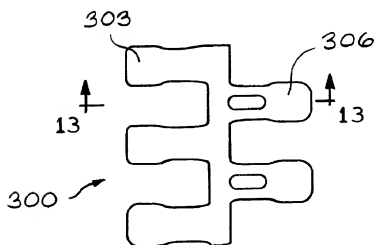


FIG. 12

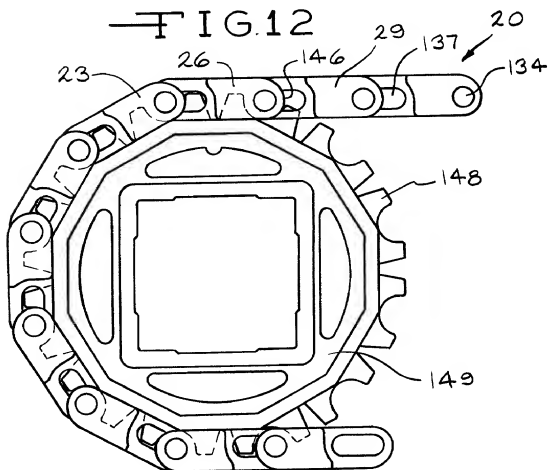


FIG. 14

Please type a plus sign inside this box ☐

PTO/SB/01 (12/97)

Approved for use through 09/30/00. OMB 0651-0032

DECLARATION FOR UTILITY OR DESIGN PATENT APPLICATION (37 CFR 1.63)		Attorney Docket Number	31259.0001
		First Named Inventor	Dieter Guldenfels
		COMPLETE IF KNOWN	
		Application Number	
<input checked="" type="checkbox"/> Declaration Submitted with Initial Filing OR <input type="checkbox"/> Declaration Submitted after Initial Filing (surcharge (37 CFR 1.16(e)) required)		Filing Date	
		Group Art Unit	
		Examiner Name	

As a below named inventor, I hereby declare that:

My residence, post office address, and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

RADIUS CONVEYOR BELT

the specification of which
☒ is attached hereto
 OR

(Title of the Invention)

☐ was filed on (MM/DD/YYYY) [] as United States Application Number or PCT International Application Number [] and was amended on (MM/DD/YYYY) [] (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment specifically referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56.

I hereby claim foreign priority benefits under 35 U.S.C. 119(a)-(d) or 365(b) of any foreign application(s) for patent or inventor's certificate, or 365(a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or of any PCT international application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application (Numbers)	Country	Foreign Filing Date (MM/DD/YYYY)	Priority Not Claimed	Certified Copy Attached? YES NO	
			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

☐ Additional foreign application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto.

I hereby claim the benefit under 35 U.S.C. 119(e) of any United States provisional application(s) listed below.

Application Number(s)	Filing Date (MM/DD/YYYY)	<input type="checkbox"/> Additional provisional application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto.

Please type a plus sign inside this box ☐

PTO/SB/01 (12/97)

Approved for use through 09/30/00, OMB 0651-0032

DECLARATION - Utility or Design Patent Application

I hereby claim the benefit under 35 U.S.C. 120 of any United States application(s), or 365(c) of any PCT international application designating the United States of America, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT international application in the manner provided by the first paragraph of 35 U.S.C. 112. I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application.

U.S. Parent Application or PCT Parent Number	Parent Filing Date (MM/DD/YYYY)	Parent Patent Number (if applicable)

☐ Additional U.S. or PCT international application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto.

As a named inventor, I hereby appoint the following registered practitioner(s) to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith:

☐ Customer Number → Place Customer Number Bar Code Label Here

☒ Registered practitioner's name/registration number listed below

Name	Registration Number	Name	Registration Number
David L. Principe	39,336	R. Kent Roberts	40,786
Martin G. Linihan	24,926	Michael F. Scalise	34,920
Kevin D. McCarthy	35,278	Daniel C. Oliverio	33,435
Ranjana Kadle	40,041	Edwin T. Bean, Jr.	16,639

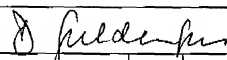
☐ Additional registered practitioner(s) named on supplemental Registered Practitioner Information sheet PTO/SB/02C attached hereto

Direct all correspondence to: ☐ Customer Number OR ☒ Correspondence address below

Name	David L. Principe					
Address	Hodgson, Russ, Andrews, Woods & Goodyear LLP					
Address	One M&T Plaza, Suite 2000					
City	Buffalo	State	New York	ZIP	14203-2391	
Country	United States	Telephone	(716) 856-4000	Fax	(716) 849-0349	

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Name of Sole or First Inventor: ☐ A petition has been filed for this unsigned inventor

Given Name (first and middle [if any])				Family Name or Surname			
Dieter				Guldenfels			
Inventor's Signature				Date	May 24, 2000		
Residence: City	Pfeffingen	State		Country	Switzerland	Citizenship	Swiss
Post Office Address							
Post Office Address	Im Steinler 18						
City	Pfeffingen	State		ZIP	CH-4148	Country	Switzerland

☐ Additional inventors are being named on the supplemental Additional Inventor(s) sheet(s) PTO/SB/02A attached hereto.

00579600 00060606